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## **Ice Thickness Distribution Test**

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### **LONG TERM GOALS**

Our long term goal is to undertake an experiment that will test the theory of how sea ice thickness distribution is changed by thermodynamics and by large-scale deformation. The minimal experiment envisaged involves two sequential surveys of ice draft in some region by an upward-looking sonar carried on a submarine. The theory is tested by seeing whether the change predicted over the time interval between the two surveys matches the change observed by submarine.

### **OBJECTIVES**

The objective of this work is to answer sampling questions about how much data is required to provide a definitive test, and how to design an experiment. How densely must a region be surveyed and how much time should elapse before the repeat survey?

### **APPROACH**

We densely survey an area of sea ice by submarine sonar and see how the estimate of thickness distribution is affected by including all or only portions of the data. Such tests allow us to calculate error bars on surveys of a given size, and allow us to design future experiments. An experiment must produce a signal—a thickness change—large enough to be measured without question above the noise—small scale variations in ice thickness.

### **ACCOMPLISHMENTS**

With the 1996 SCICEX data we have been investigating how the variance of an estimate drops off with increasing sample size and find that the drop-off is less rapid than the usual reciprocal of sample size. A paper on this behavior is in preparation.

While waiting for 1996 cruise data, we began working with 1993 SCICEX ice draft data, which consisted of a long u-shaped transect across the whole Arctic Ocean.

We compared these data with model output, testing how much of the variations of ice draft seen in the data showed up in the model. This work is preliminary and awaits more extensive submarine data, hopefully from the historical record from the 1970's. This work was reported at the Ice Thickness Workshop in Monterey in April 1997.

## **SCIENTIFIC RESULTS**

We have found unexpected behavior of ice draft profile data which shows that the decrease in variance of ice draft statistics with increasing sample size is slower than for more common data sets. The properties are seen in the autocorrelation at long (spatial) lags and in the spectra at the shortest wavenumbers.

## **IMPACT FOR SCIENCE**

If sea ice models are to assume their proper place in global climate models, they must be validated with data as we are doing here.

## **TRANSITIONS**

None.

## **RELATED PROJECTS**

*Ice Thickness Distribution Test--Stage 2*, National Science Foundation Grant OPP-9617343, D.A. Rothrock, principal investigator, G.A. Maykut and A.S. Thorndike, co-investigators.

*Polar Exchange at the Sea Surface*, National Aeronautics and Space Administration Grant No. NAGW-2407 D. A. Rothrock, principal investigator

## **PUBLICATIONS**

Yu, Y., and D.A. Rothrock, Thin ice thickness from satellite thermal imagery, *J. Geophys. Res.*, 101(C10), 25,753-25,766, 1996.

Thomas, D.R., S. Martin, D.A. Rothrock, and M. Steele, Assimilating satellite concentration data into an Arctic Sea ice mass balance model, 1979-1985, *J. Geophys. Res.*, 101(C9), 20,849-20,868, 1996.